Musculoskeletal system Assessment

By

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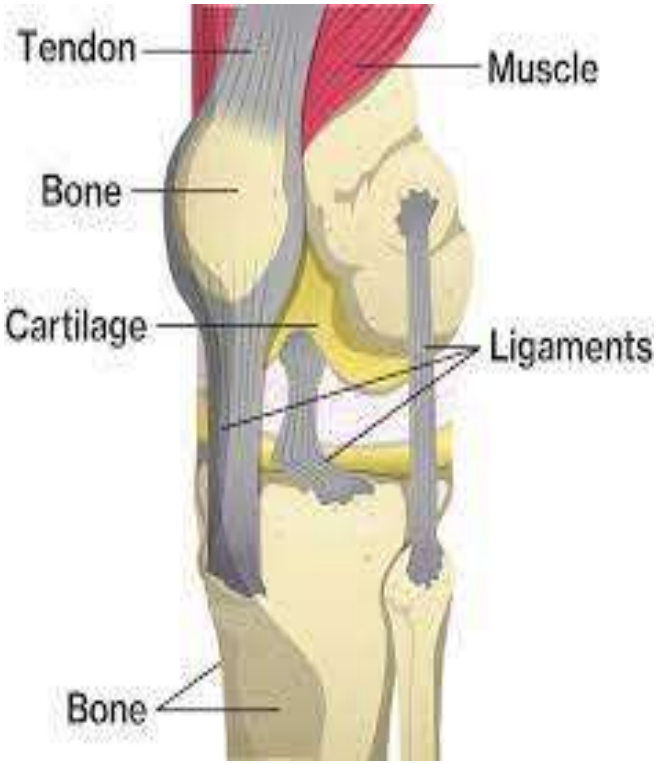
Learning Objectives

- **On completion of this lecture, the students will be able to:**
- Describe the anatomy and physiology of the musculoskeletal system.
- Discuss the significance of the health history to the assessment of musculoskeletal health.
- Describe the significance of physical assessment to the diagnosis of musculoskeletal dysfunction.
- Specify the diagnostic tests used for assessment of musculoskeletal function.

Introduction

- The musculoskeletal system includes the bones, joints, muscles, tendons, and ligaments.
- Diseases and injuries that involve the musculoskeletal system are commonly implicated in disability and death.
- Musculoskeletal diseases and injuries can significantly affect overall productivity, independence, and quality of life in people of all ages.



Anatomy

There are 206 bones in the human body, divided into four categories:

- Long bones (e.g. femur)
- Short bones (e.g. metacarpals)
- Flat bones (e.g. sternum)
- Irregular bones (e.g. vertebrae)

There are **650** muscles in the human body, divided into three categories:

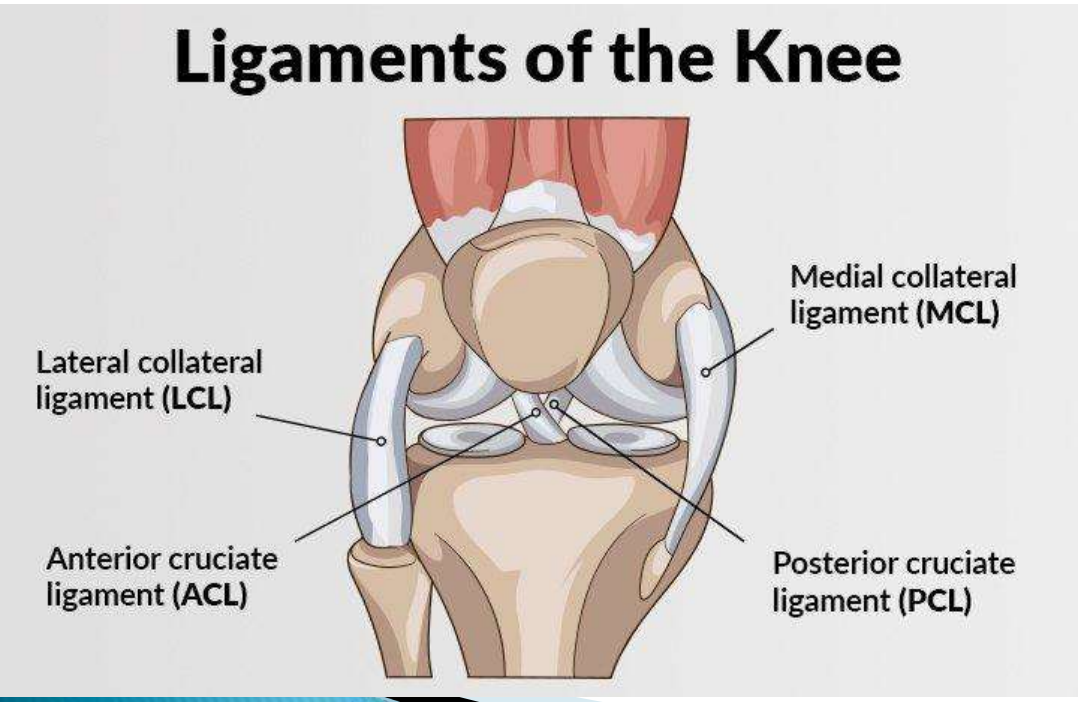
- Skeletal
- Smooth
- Cardiac

- voluntary (elbow)
- Semi-voluntary (diaphragm)
- involuntary (heart) movement

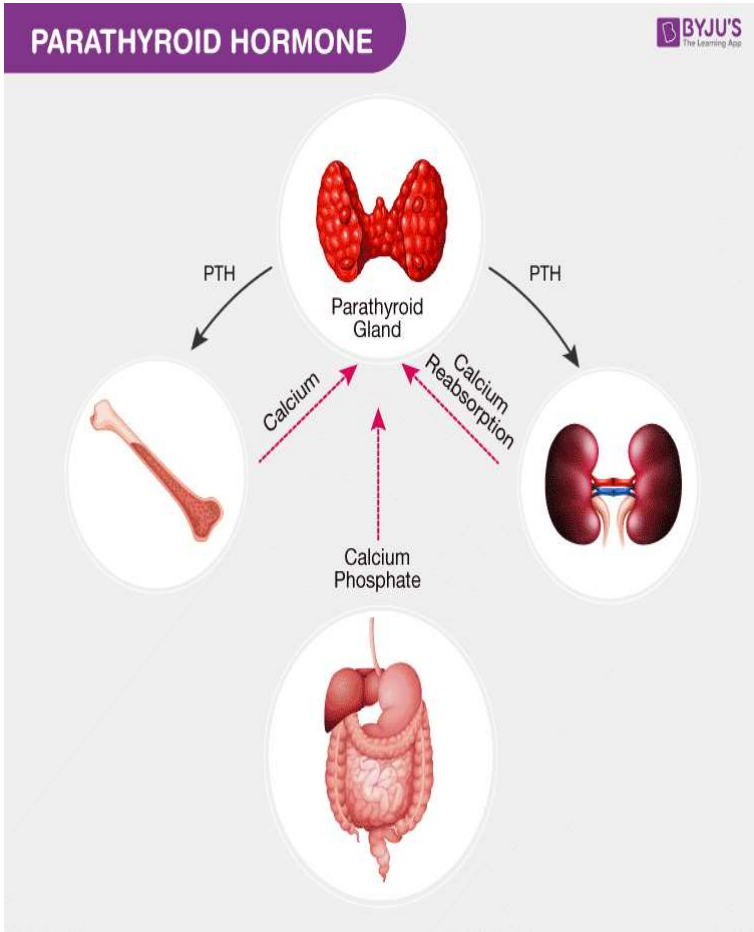
Anatomy & physiology

- The musculoskeletal system provides protection for vital organs, including the brain, heart, and lungs;
  - **Bones** provides a strong framework to support body structures; and makes mobility possible.
  - Joints
  - **Muscles** and tendons hold the bones together and joints allow the body to move.

- **Ligament:** fibrous connective tissue bands connect bones together
- **Tendons** move to produce heat that helps maintain body temperature.
- The ends of long bones are covered at the joints by articular cartilage.

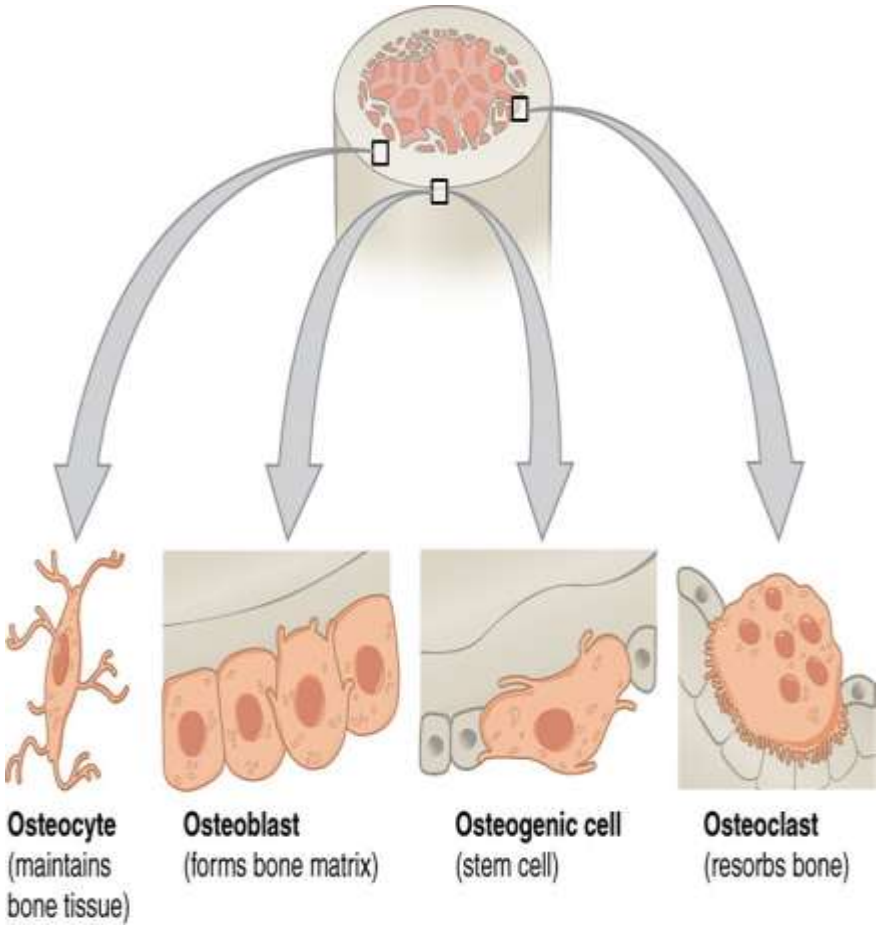


- Movement facilitates the return of deoxygenated blood to the right side of the heart by massaging the venous vasculature.
- Bone is composed of cells, protein matrix, and mineral deposits.
- The musculoskeletal system serves as a reservoir for immature blood cells and essential minerals, including calcium, phosphorus, magnesium, and fluoride.



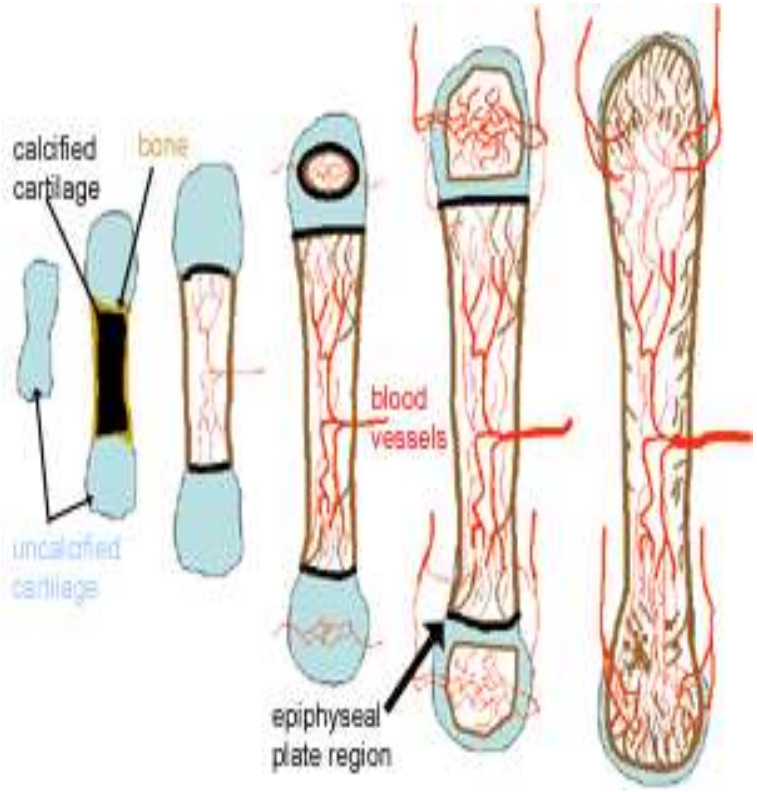
Anatomy and physiology

- The **cells** are of three basic types—**osteoblasts, osteocytes,** and **osteoclasts.**
- Osteocytes are mature bone cells involved in bone-maintenance functions.
- Osteoblasts function in bone formation by secreting bone matrix.
- Osteoclasts are cells involved in destroying, resorbing, and remolding bone.



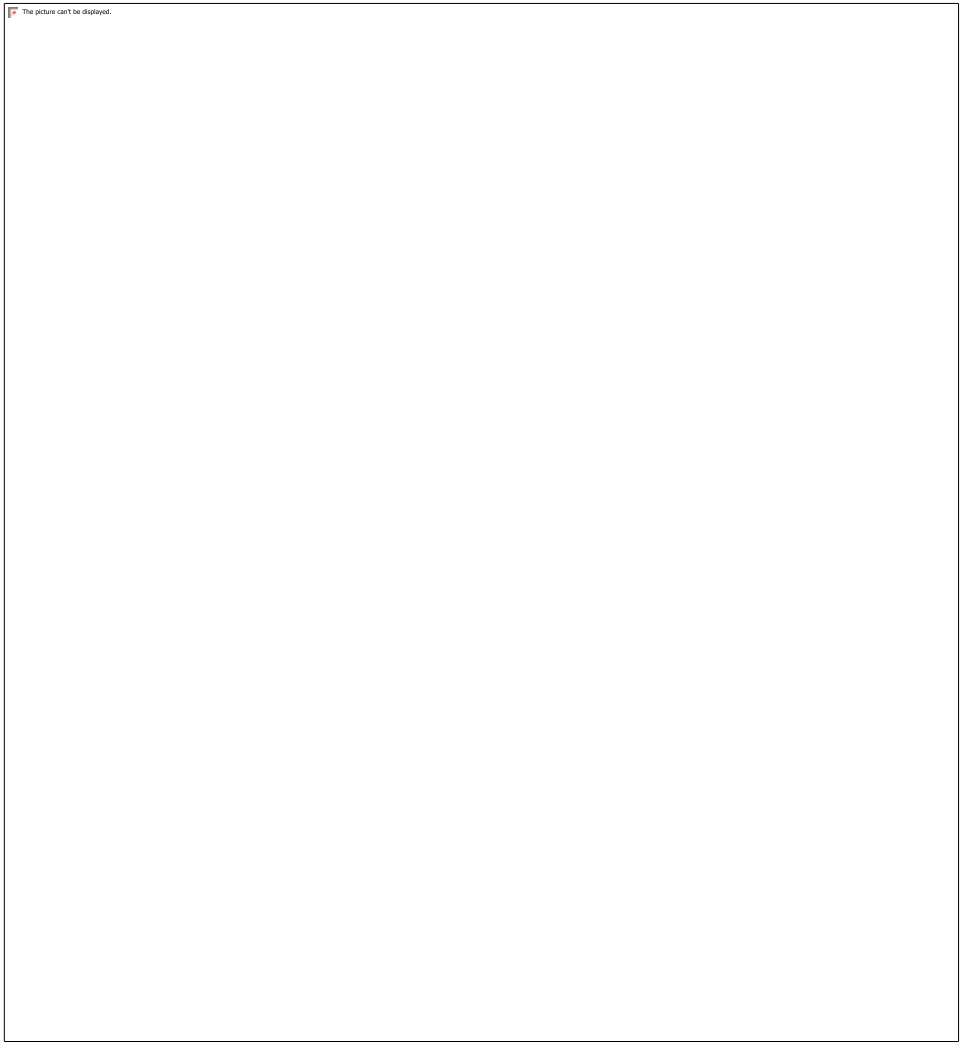
Bone Formation (Osteogenesis)

- Ossification is **the** process by which the bone matrix (collagen fibers and ground substance) is founded and hardening minerals (e.g. calcium salts) are deposited on the collagen fibers.
- The collagen fibers give tensile strength to the bone, and the calcium provides compressional strength.



Bone homeostasis (Maintenance)

- **Bone homeostasis** is maintained by a balance between bone resorption by osteoclasts and bone formation by osteoblasts.
- Resorption is **the breakdown and assimilation of old bone in the cycle of bone growth**. The process of resorption (remodeling) involves the removal of hard bone tissue by osteoclasts followed by the laying down of new bone cells by osteoblasts.



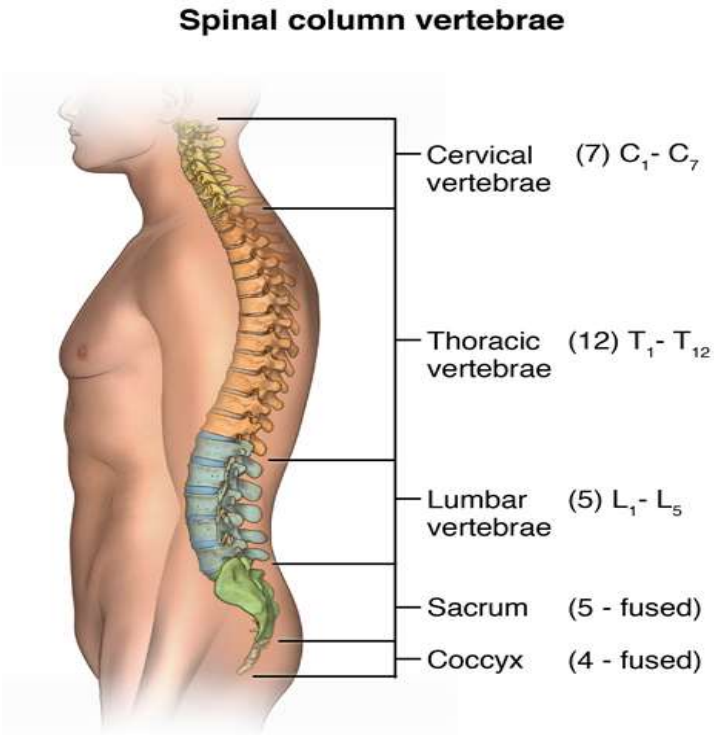
Bone Maintenance

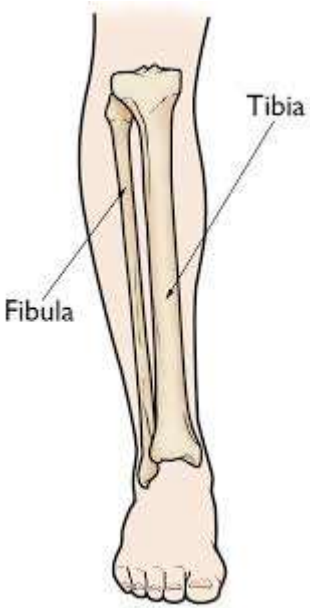
The important regulating **factors** that determine the balance between bone formation and bone resorption include:

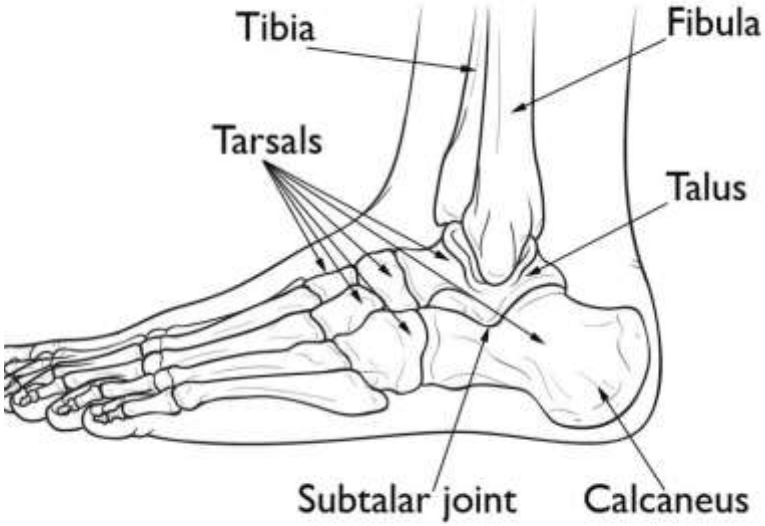
1. **Physical activity:** (weight bearing) acts to simulate bone formation and remodeling. Weight-bearing bones are thick and strong.

- Without weight-bearing or stress, as in prolonged bed rest, the bone loses calcium (resorption) and becomes osteopenic قلة العظم & weak. The weak bone may fracture easily.

Ex: Weight-bearing bones

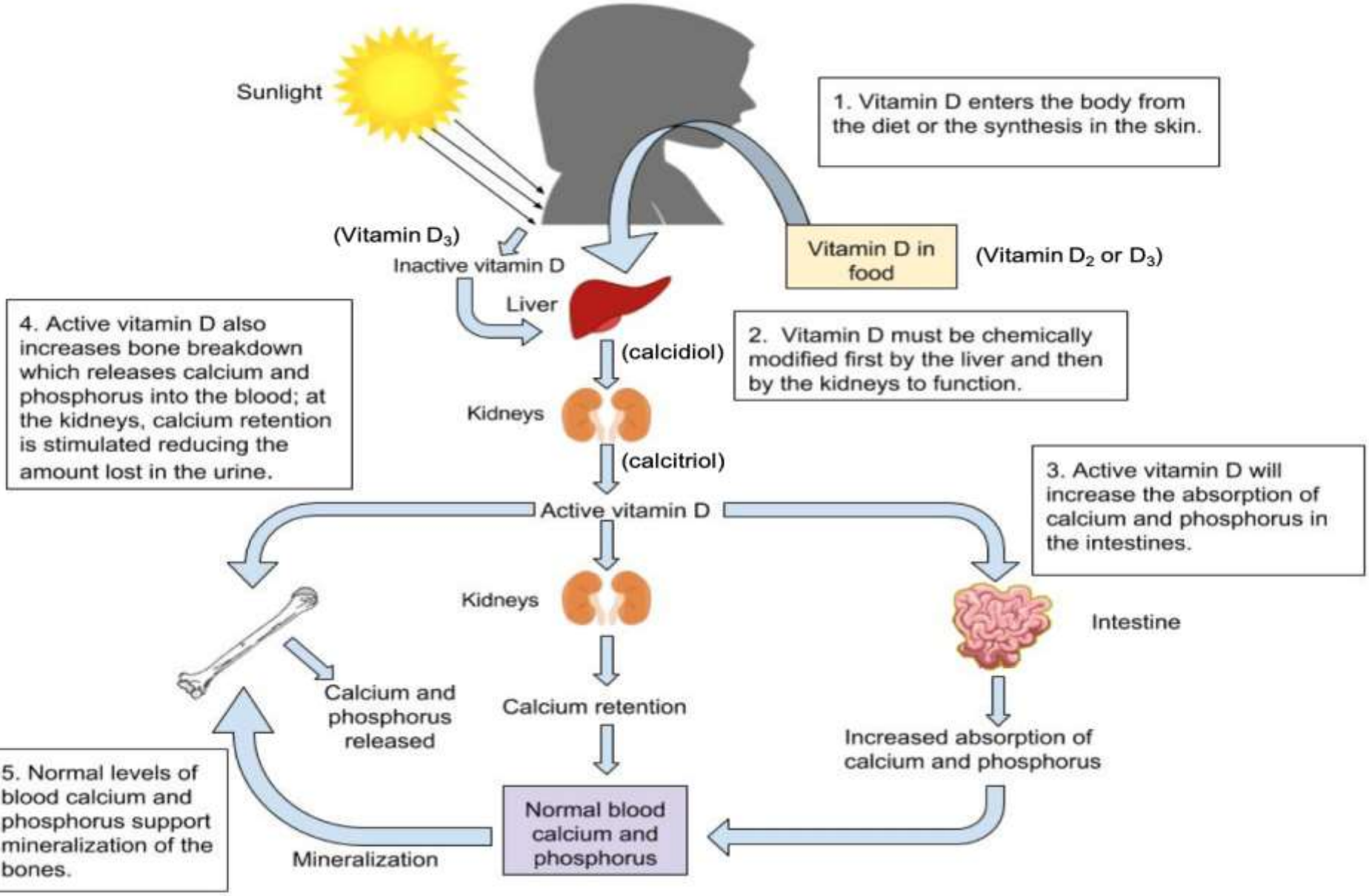






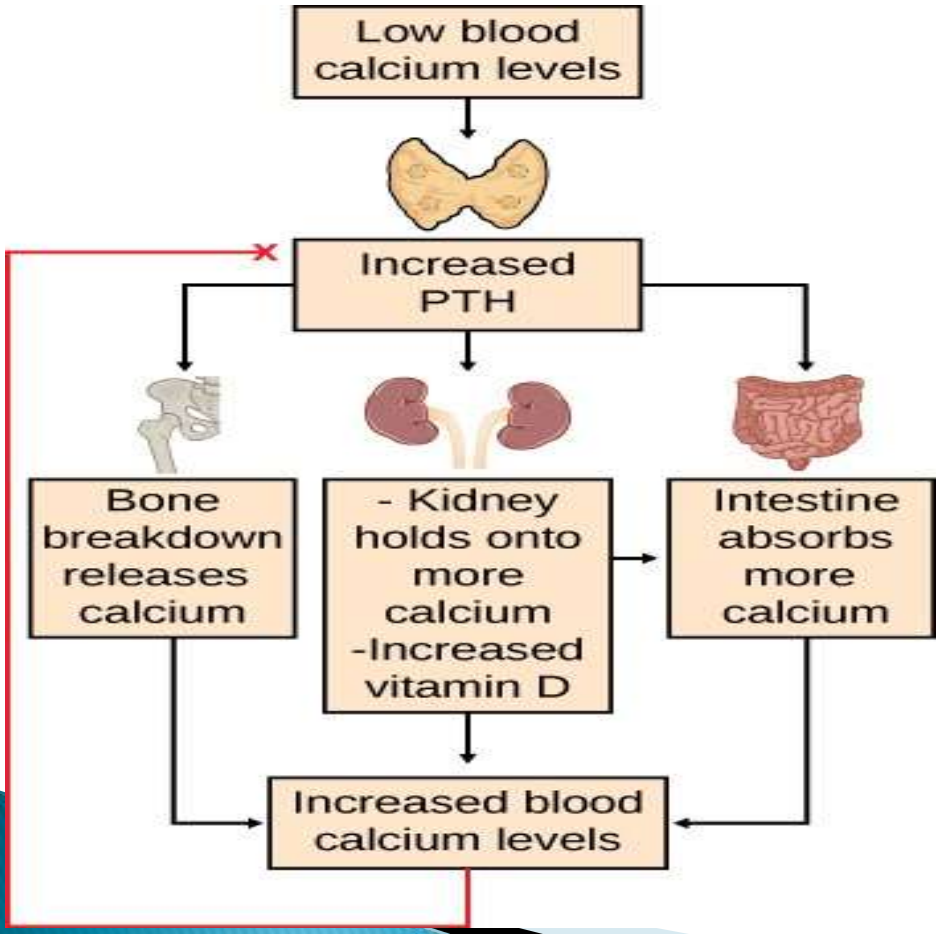
- **2. Good dietary habits:** absorption of approximately 1-1.2 gm of Ca daily is essential to maintaining adult bone mass.

3. Biologically active vitamin D (calcitriol)

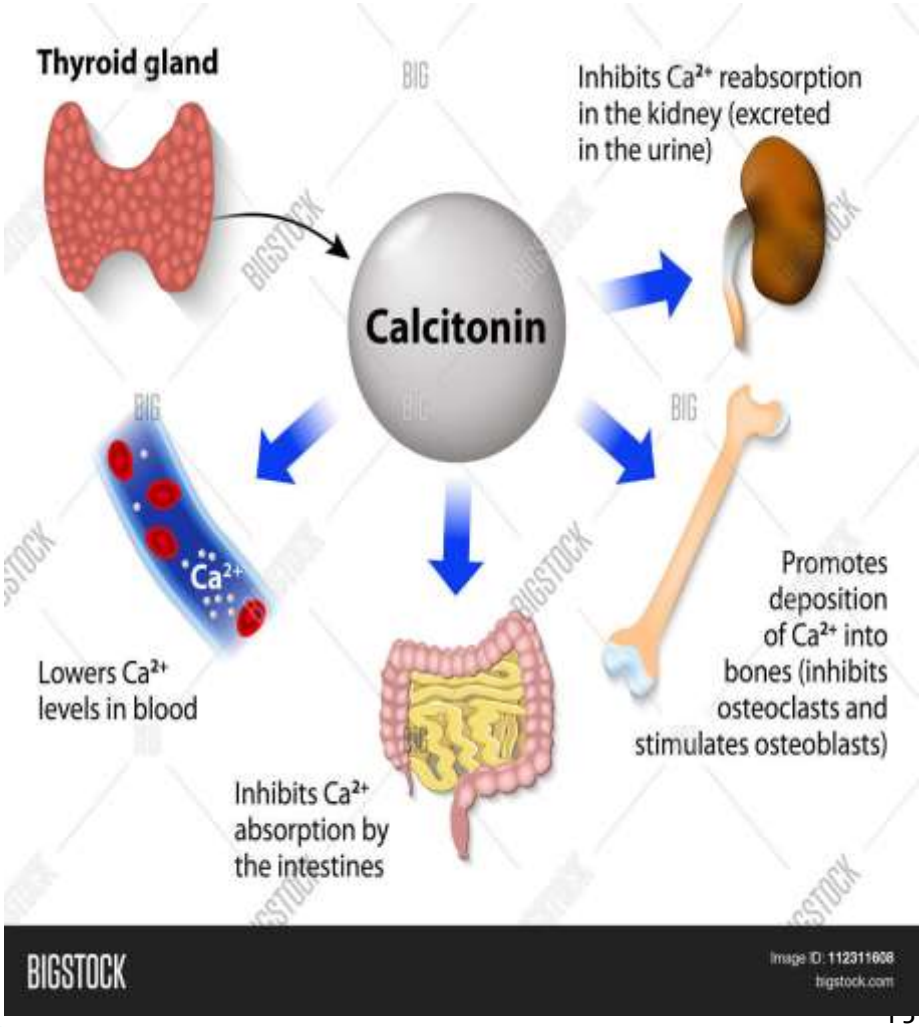


Bone Maintenance

3. Parathyroid hormone



4. Calicitonin



Bone Maintenance

- **5. Growth hormone**: It stimulates the liver and bones to produce insulin-like growth factor-1 (IGF-I), which accelerates bone modeling in children and adolescents. GH also directly stimulates skeletal growth in children and adolescents.
- the low levels of both GH and IGF-I that occur with aging responsible for decreased bone formation and resultant osteopenia

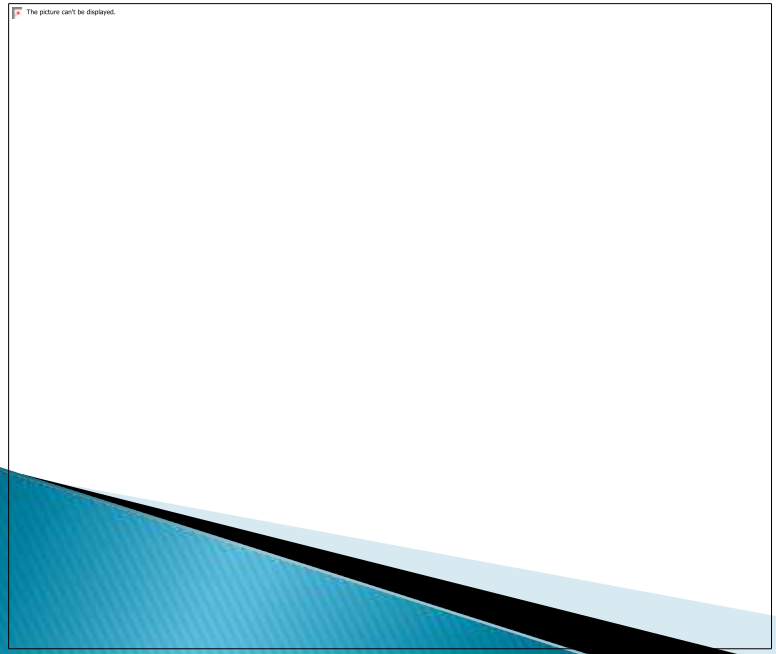
Bone Maintenance

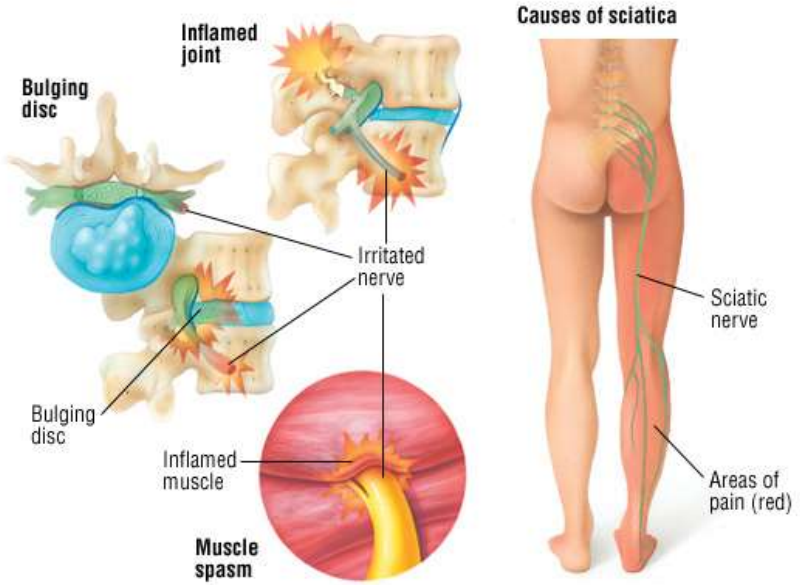
- **6. Sex hormones (**testosterone and estrogen): Estrogen stimulates osteoblasts and inhibits osteoclasts; therefore, bone formation is enhanced and resorption is inhibited.
- Testosterone : causes skeletal growth in adolescence and throughout the lifespan. resulting in increased bone formation. In addition, testosterone converts to estrogen in adipose tissue, providing an additional source of bone preserving estrogen for aging men.
- **7. Blood supply:** Bone necrosis occurs when the bone is deprived of blood… **Avascular necrosis/ Osteonecrosis**

Assessment/ Health history

- **Pain:** Bone pain is described as a dull, deep ache that is "boring" in nature. Whereas muscular pain is described as soreness 'muscle pain are tension, stress' or aching and is referred to as "muscle cramps."
- Pain that increases with activity may indicate joints sprain or muscle strain. Radiating pain occurs in conditions in which pressure is exerted on a nerve root.

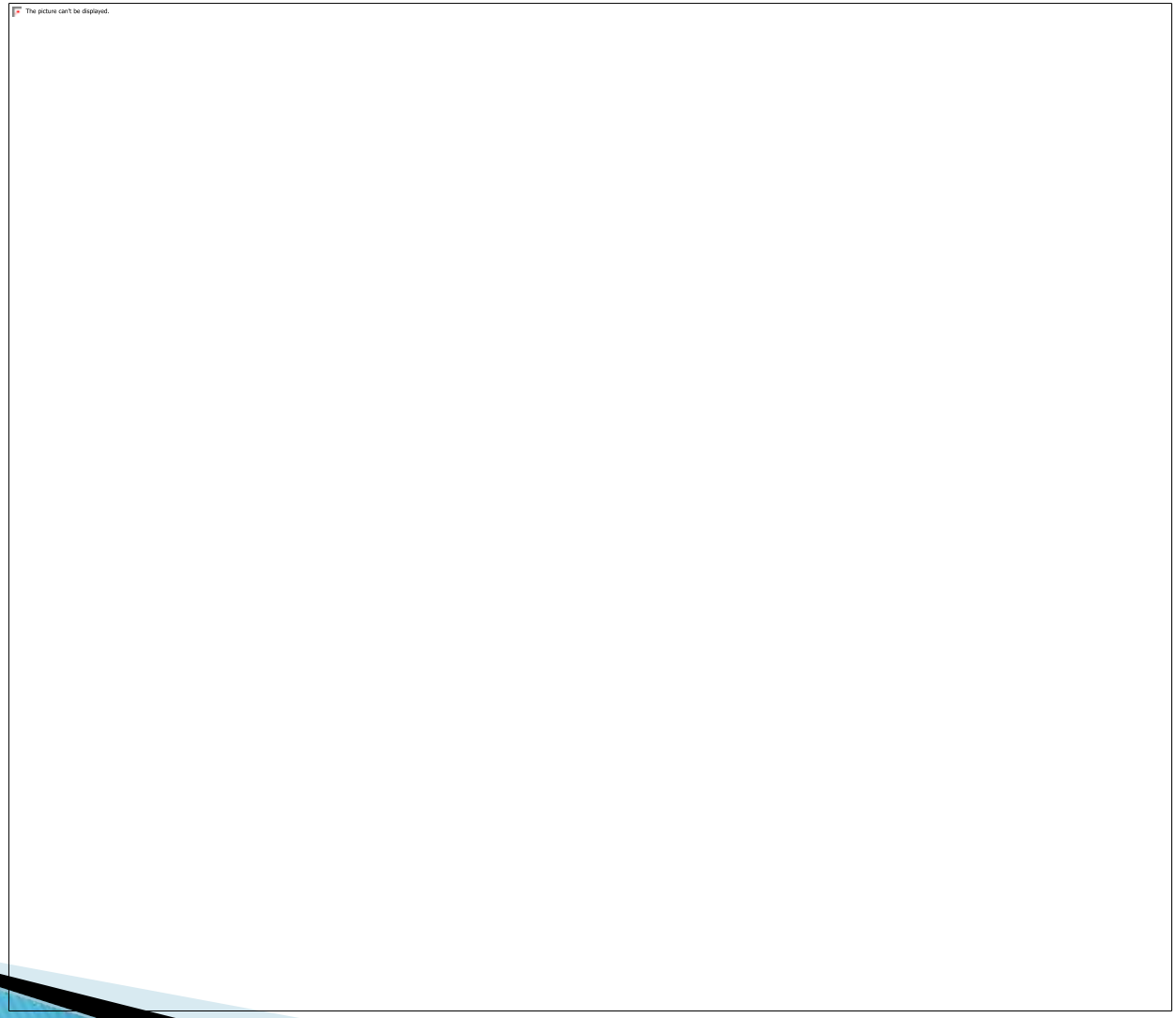
- **Altered Sensation:** The patient may describe **paresthesias,** which are burning, tingling sensations or numbness. Caused by pressure on nerves or by circulatory impairment. Soft tissue swelling or direct trauma to these structures can impair their function.





Assessment/ Physical Assessment

- **Posture**: **kyphosis, an increased** forward curvature of the thoracic spine; **lordosis**, an exaggerated curvature of the lumbar spine; and **scoliosis**, **a lateral** curving deviation of the spine
- **Gait:** Gait is assessed by having the patient walk away from the examiner for a short distance.
- **Bone Integrity**: The bony skeleton is assessed for deformities and alignment. Symmetric parts of the body are compared.
- **Joint Function**: The articular system is evaluated by noting range of motion, deformity, stability, and nodular formation.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Three types of ROM:

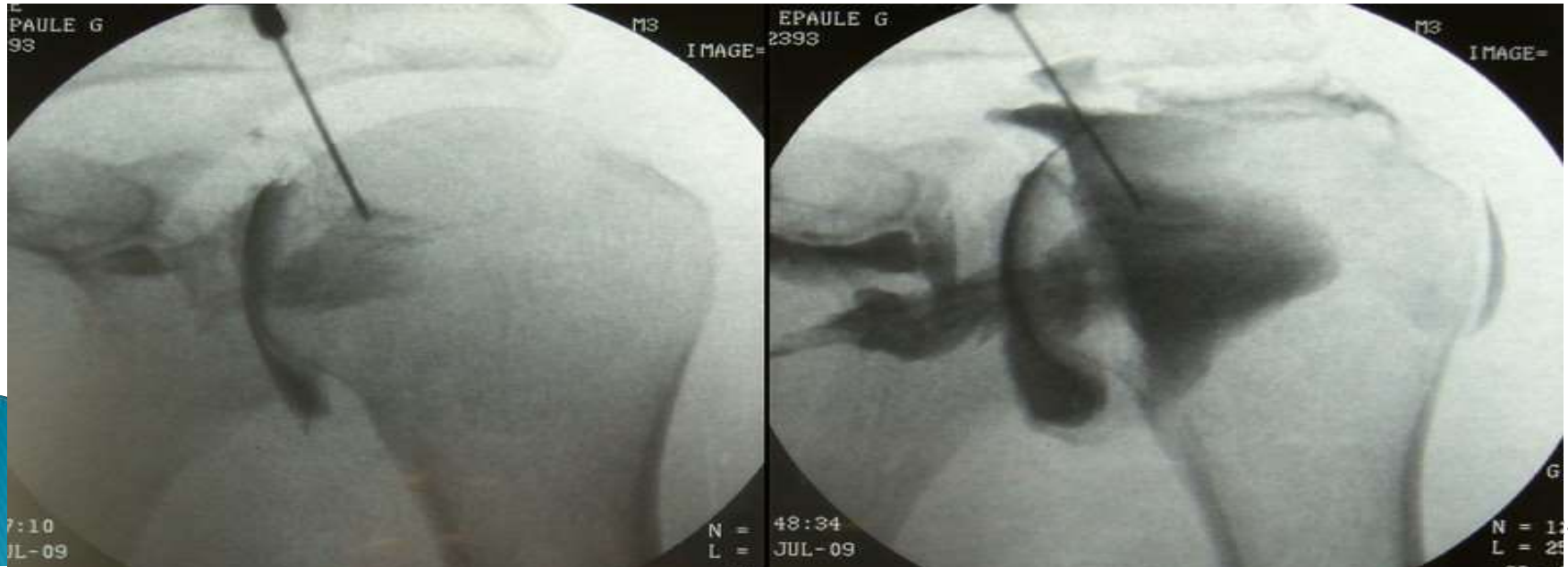
1. **Active Range of Motion:** Patient performs the exercise independently without any assistance.
2. **Active Assisted Range of Motion:** Patient moves the joints with some effort and requires some assistance from someone or equipment.
3. **Passive Range of Motion:** Patient does not perform any movement and depends totally on someone (therapist) or equipment to perform ROM.

Assessment/ Diagnostic Evaluation

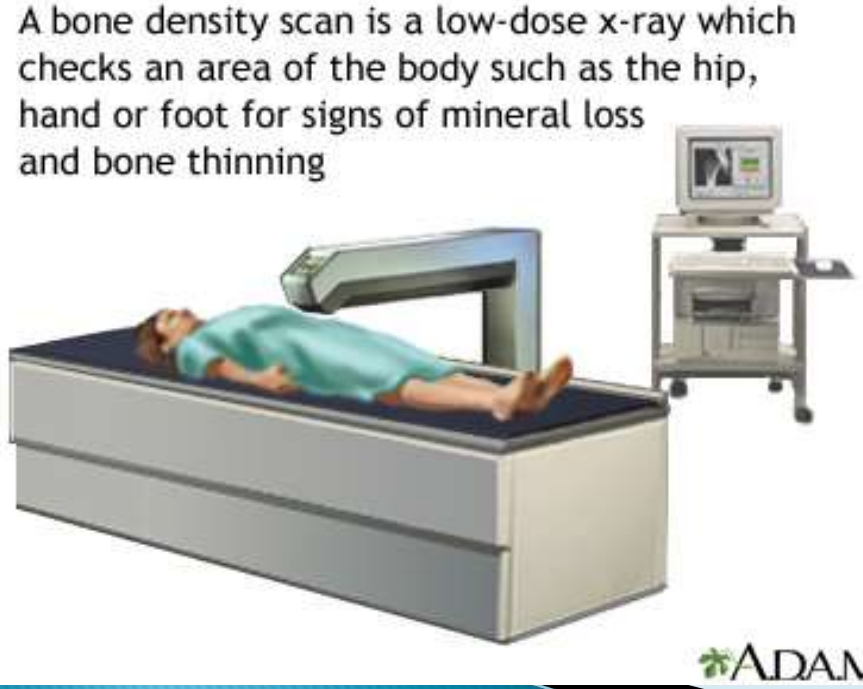
- Imaging procedures
- 1- X-ray Studies: Bone x-rays determine bone density, texture, and changes in bone relationships.
- 2-Compured Tomography CT scan: can reveal tumors of the soft tissue or injuries to the ligaments or tendons, & fractures(with or without contrast).
- 3-Magnetic Resonance Imaging MRI: to demonstrate soft tissues abnormalities (ie, tumors)

Diagnostic Evaluation

- **4- Arthrography** is useful in identifying acute or chronic tears of the joint capsule or supporting ligaments of the knee, shoulder, ankle, hip, or wrist. A radiopaque contrast agent or air is injected into the joint. distribute the contrast agent while a series of x-rays is obtained. If a tear is present, the contrast agent leaks out of the joint and is evident on the x-ray image.



- **5- Bone densitometry** is used to estimate bone mineral density (BMD). This can be done through the use of x-rays or ultrasound for diagnosing osteoporosis and predicting a person's risk for fracture.



Nursing Interventions

- Assess for conditions that may require special consideration during the study or that may be contraindications to the study (e.g. pregnancy; claustrophobia; inability to tolerate required positioning due to age, or disability; metal implants).
- The patient should remove all jewelry, hair clips, hearing aids, and other metal before having an MRI.
- Check for possible allergy if contrast agents will be used for CT scan, MRI, or Arthrography.

Nuclear studies

- Bone Scan: to detect metastatic and primary bone tumors, osteomyelitis, some fractures, and aseptic necrosis. An increased uptake of isotope is seen in skeletal disease.
- Nursing interventions
- Check for allergy to the radioisotope and should assess for any contraindications(e.g. pregnancy).
- Encourage the patient to drink plenty of fluids to help distribute and eliminate the isotope.
- Before the scan, the nurse asks the patient to empty the bladder, because a full bladder interferes with scanning of the pelvic bones.

Endoscopic studies

- Arthroscopy: is a procedure that allows direct visualization of a joint to diagnose joint disorders. Treatment of tears, defects may be performed through the arthroscopy.
- Nursing interventions
- The joint is wrapped with a compression dressing to control swelling. In addition, ice may be applied to control edema and discomfort.
- Keep the joint extended and elevated to reduce swelling.
- Administers prescribed analgesics to control discomfort.
- Teaching about activity resume and any symptoms (eg, swelling, numbness, cool skin) for possible complications (infection, stiffness, and delayed wound healing).

Other studies

- Biopsy: may be performed to determine the structure and composition of bone marrow, bone, muscle, or synovium to help diagnose specific diseases.
- The nurse monitors the biopsy site for edema, bleeding, pain, and infection.
- Ice is applied as prescribed to control bleeding and edema.
- In addition, analgesics are administered as prescribed for comfort.

Laboratory studies

- The complete blood count includes:
  - Hemoglobin level
  - White blood cell count (which is elevated in acute infections, trauma, acute hemorrhage, & tissue necrosis).
- Serum calcium levels are altered in patients with osteomalacia, parathyroid dysfunction, Paget's disease, metastatic bone tumors, or prolonged immobilization.
- Serum phosphorus levels are inversely related to calcium levels and are diminished in osteomalacia associated with malabsorption syndrome.
- Urine calcium levels increase with bone destruction (e.g. parathyroid dysfunction, metastatic bone tumors, multiple myeloma).